Space Weather Technical Forecast

Issued on Wednesday, 12 October 2022 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with C-class flares observed from the region of AR3112 (Fai/Beta-Gamma). Peak flare was C6.2 at 11/1819 UTC, although a potentially more notable long period C3.7 flare was observed lasting around 5.5 hours from this region (12/0505-1035). This region has shown some simplification as it approaches the western limb, with visible spots appearing to shrink in size, most notably the trailer but also the leader resulting in its reclassification. AR3116 (Hsx/alpha) to the north of this region, also simplified to a unipolar spot. C-flaring was also observed from AR3119 Dsi/Beta, also in the northwest quadrant, but closer to the centre disc, however this remains a smaller and simpler region. A central disc coronal dimming was observed around 11/1200-1300UTC however this did not produce any analysable CMEs. The long period C-flare also has the potential to produce a CME, however none has yet to be observed, and would likely be off the Earth-Sun line. No other CME candidates were observed, however there are also a number of filaments that will need to be monitored for any potential lift.

Solar Wind / Geomagnetic Activity: The solar wind speed, as observed at L1, declined to background from 450 km/s to 350-400 km/s with Earth becoming embedded within the ambient slow wind. Density persisted at or below average. The total IMF strength, Bt, has been weak at below 5nT, with the north-south component, Bz predominately, but weakly negative. The phi angle was initially positive (away from the Sun), but exhibited two solar sector boundary crossings (SSBs), becoming negative (towards the Sun) between 11/2140-12/1052 UTC. Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has been at background levels. High energy electron flux (greater than 2MeV) has been at moderate to high levels, peaking at 4650 pfu at 11/1730UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout. The 12/0000 UTC observation was 2.07e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate with an ongoing chance of M-flares, primarily from AR3112 but potentially from AR3119 or other smaller regions on the disc.

Solar Wind / Geomagnetic Activity: There is a CME that while likely to miss Earth on day 3 (14th), has a small chance of giving a peripheral influence as it passes. Otherwise Earth will likely see background winds persisting through much of the period, before the arrival of the fast wind of CH32/- late on day 3 or more likely day 4 (14th or 15th). Geomagnetic activity will be mostly Quiet with a chance of isolated Unsettled intervals, perhaps increasing to Active with any fast wind arrival later in the period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background, but with a daily slight chance of rising in response to any large flares from AR3112. The high energy electron flux (greater than 2 MeV) is likely to persist at

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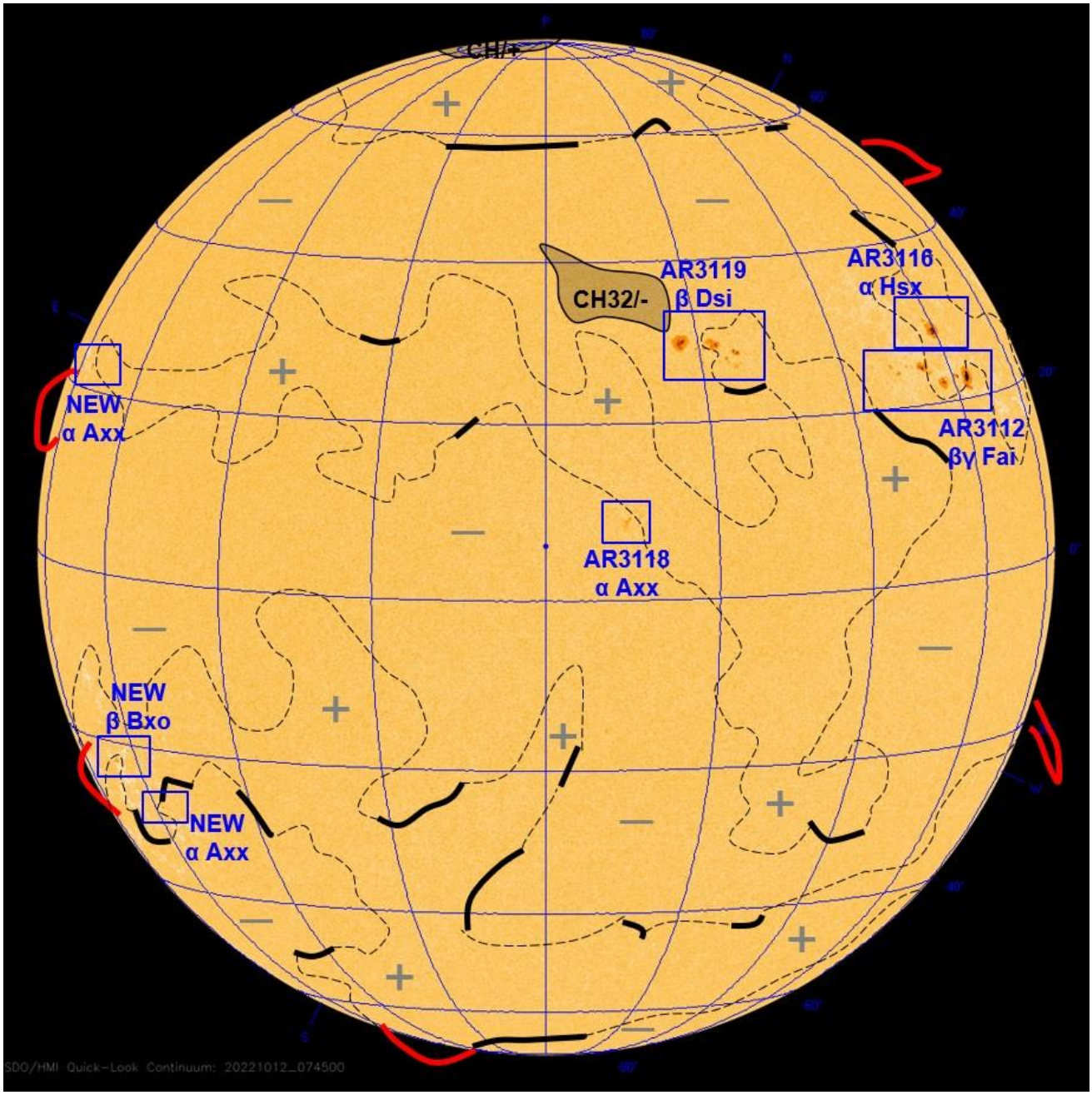
predominately High levels, only falling in response to any fast wind arrival late day 3 or day 4 (14th or 15th). The associated electron fluence is forecast to persist at Active levels, albeit with decreasing confidence.

Figure 1. Solar Analysis Valid 12/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

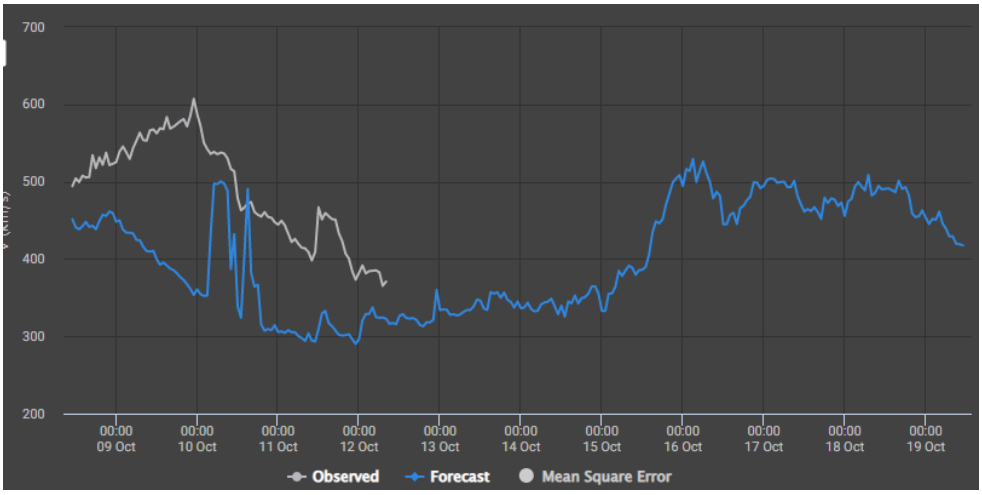
There is a weak CME which may have peripheral influences on the geomagnetic forecast, but expected to miss. This is from a filament eruption on 9th, which will likely pass Earth's orbital distance on day 3 (14th). A central disc dimming on the 11th, has not produced an identifiable CME. Further CMEs from the M-flares of AR3912 on previous days have also been assessed as missing.

Solar winds are currently at background levels, with Earth embedded with an ambient slow wind environment. The next coronal hole fast wind enhancement is anticipated to be from CH32/- late day 3 (14th) or day 4 (15th). This feature was larger in western extent on the previous rotation, but following persistence would not be expected until day 4 (15th). Enlil currently has a weak enhancement on the 13th (day 2), however this is too soon to be due to CH32, with the subsequent enhancement it shows later on the 15th (day 4) and into the 16th, closer in agreement with persistence.

Mainly Quiet geomagnetic activity is expected with isolated Unsettled intervals. There is a chance of Active intervals day 3 or more likely day 4 (14th or 15th) from any fast wind arrival with a very slight chance of G1/Minor Storms, mainly if any influence from the passing CME occurs.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2b: Solar Wind Persistence Model



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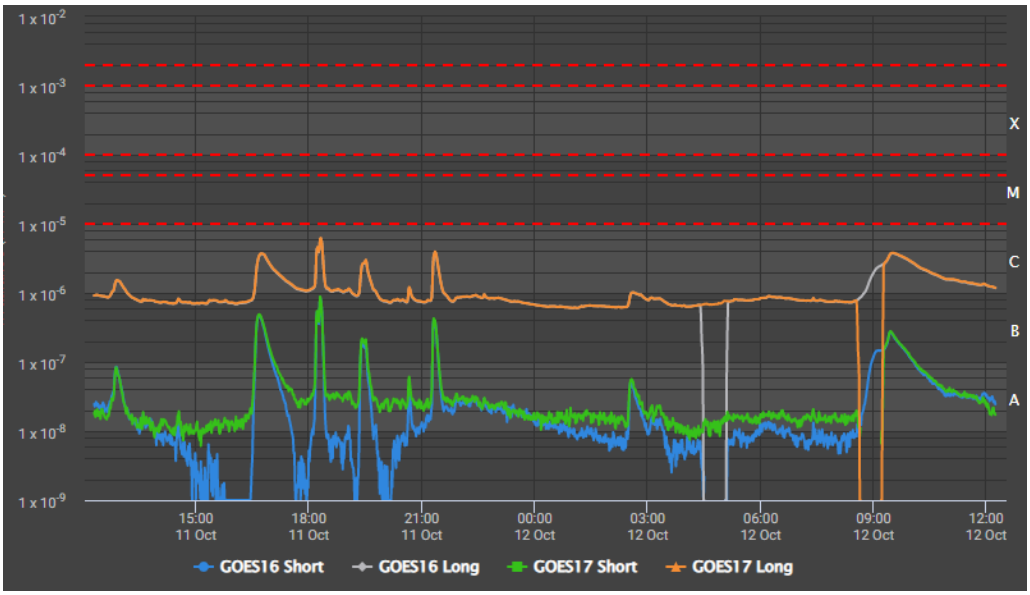
Radio Blackouts - X-Ray Flares:

There are four numbered sunspot regions on the disc, all in the northwest quadrant. Activity has been Low, although frequent C-flares have been observed from AR3112 Fai/Beta-gamma. This is despite this region showing a gradual decline in areal extent, especially in its trailer but also its leader, resulting in a slight simplification with its classification. The region to the north of this AR3116 Hsx/alpha has also simplified, to a small unipolar region. The other region of interest is AR3119 Dsi/Beta, which has also produced a few C-flares, however this remains relatively smaller and simpler. There are also three very small and currently unnumbered flux emergences towards the east limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	10
Very Active	R3 to R5 X Class	No	2	2	2	1

Figure 3: GOES 16-17 X-ray Flux



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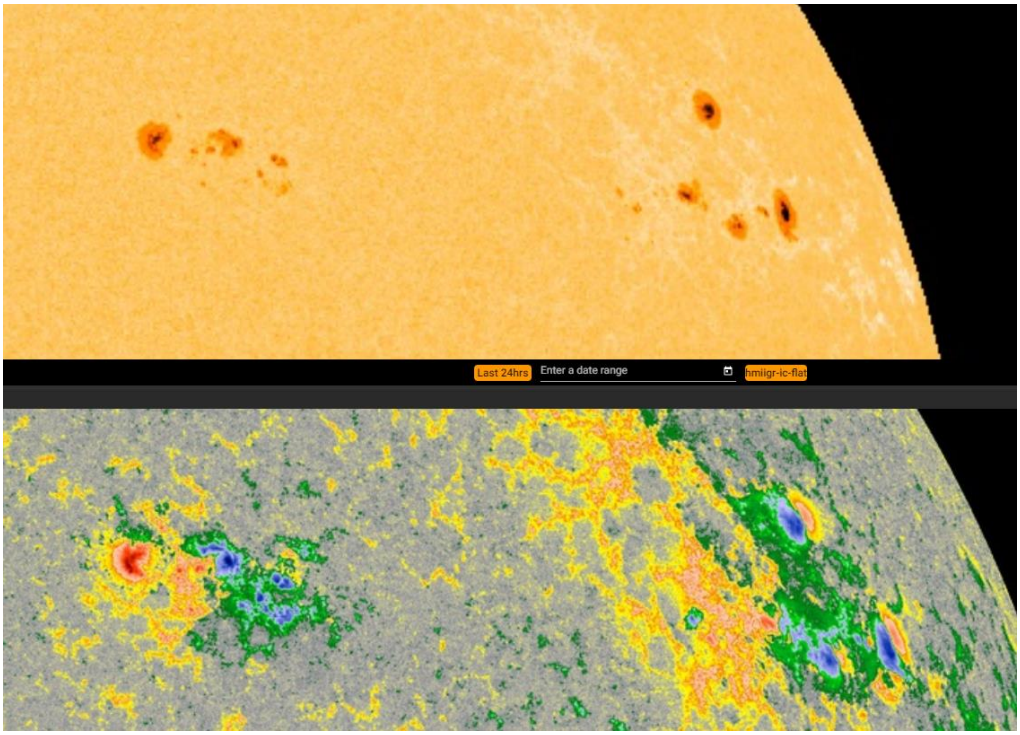
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES-16 is currently at background levels. Despite recent flaring over the last couple of days from AR3112, which is in a geoeffective location for proton storming, no observable high energy proton flux has been observed. With this sunspot now appearing to have simplified slightly, and no other significant regions, there is a reduced chance of notable flares, and subsequently only a very slight chance of approaching, or exceeding, the S1 threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Hmi-Intensitygram and Magnetogram of NW disc.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES 16 is currently High (1000 pfu). With no significant solar wind enhancement expected until the arrival of the fast winds of CH32/- late on the day 3 (14th) or during day 4 (15th) then these levels are expected to persist for much of the period, albeit with a chance of the peak flux declining. Once this fast wind arrives, flux levels are likely to drop out to Background to Moderate.

The associated 24 hour fluence is forecast to persist at Active (above 1e9 integrated pfu) throughout the period, only significantly falling in response to any flux drop out later in the period. The current REFM forecast is giving poor guidance to current and expected conditions, so should be disregarded.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	100	80	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Flux and associated Fluence

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